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3.5 Stormwater Management

Stormwater is precipitation that does not soak into the ground or evaporate but flows along the surface of the ground as runoff. Conventional practice for stormwater management—concentrating runoff and carrying it off a site as quickly as possible through storm sewers—causes various environmental problems, including erosion and downstream flooding, pollution loading of surface waters, and reduced groundwater recharge. Responsible management of stormwater involves a combination of strategies to reduce the amount of runoff generated, to reduce the amount of pollutants that are transported in the runoff, and to remove pollutants from that runoff. Generally, the most important management strategy for stormwater is to provide for infiltration into the ground as close as possible to where the precipitation falls.

Opportunities

Effective stormwater management practices should be incorporated into any new development. This should start with a thorough analysis of the existing hydrology on a site and assessment of expected stormwater flows. How stormwater is handled at *existing* facilities should also be examined and improved to the extent possible—even if "problems" are not obvious. Consider opportunities for improving stormwater management practices when any of the following occur: landscape redesign or replanting, regrading of the site in any way, excavation of utilities, reroofing of buildings, street and sidewalk modifications, and replacement, addition, or resurfacing of any paved areas. Strategies for improving stormwater management can also improve wildlife habitat on a site, improve water quality in the region, and help to recharge underground aquifers. Stormwater runoff and erosion during construction are of particular concern and generally necessitate actions well beyond practices for stormwater management once the facility is developed.

Technical Information

A stormwater analysis includes soil analysis, topography mapping, peak flow calculations, and examination of historical patterns of stormwater flow. It should also predict (with new facilities) or quantify (with existing facilities) the vehicular pollutants that reach the runoff stream, such as oil, gasoline, heavy metals, detergents, and cleaners. Fertilizers, pesticides, herbicides, and other landscaping treatments also contaminate stormwater, and their quantity must be measured in the analysis.

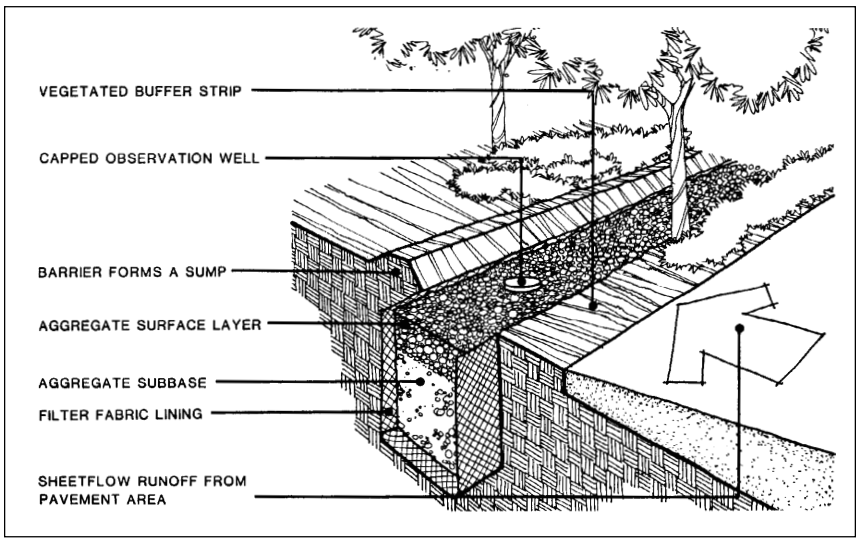
Establishing stormwater goals should be done following collection of data. With new facilities, for example, a possible target might be for the development to result in no net increase in stormwater flows off the site with any storm event up to a two-year storm in magnitude.

Avoid changes to topography, vegetation, and landforms. Most disturbances to a site, including grading (which compacts soils) and removal or disturbance of vegetation, will increase stormwater flows by reducing the ability of soils to infiltrate rainwater. Preserving original topography is generally recommended, though recontouring land, if planned and done carefully, can also improve infiltration in some cases.

Minimize impervious paved surfaces. Minimize the size of parking lots and the width of roadways. Use porous paving, such as porous asphalt, porous concrete, modular block pavers, and specialized grass-paving systems.

Separate impervious surfaces with turf, gravel, or vegetation to increase infiltration. Avoid curbs where possible—they increase the concentration of pollutants. When there are no curbs, rainwater runs off driveways, sidewalks, and roads and goes directly into the ground.

Consider green roofs as a stormwater management



From *Stormwater Management: A Guide for Floridians* (72-page overview by the Florida Department of Environmental Regulation, 2600 Stone Road, Tallahassee, FL 32399-2400)

Infiltration trench

strategy. By capturing and absorbing rainfall, green (vegetated) roofs function like stormwater detention basins by slowing down the flow of runoff. *Rainwater harvesting* systems (see *Section 6.7*) can also reduce stormwater production, though the potential benefit is determined in large part by the size of the storage cistern(s).

Clearly label stormwater sewers to discourage dumping of hazardous wastes. Photo: Robert Day

Reduce pollutants in stormwater. Minimize the use of road salt, sweep streets regularly, reduce animal waste, and reduce car use. Reducing reliance on cars can be achieved through emphasis on public transportation, bicycle and pedestrian paths, and carpooling. Avoid the use of herbicides, pesticides, and fertilizers in the landscape. Discourage dumping of motor oil, antifreeze, and other hazardous wastes into storm drains—let people know through clear signage that storm drains lead directly to streams and rivers.

Rely on natural "biofiltration" systems to remove pollutants. Vegetated swales, vegetated infiltration basins, and constructed wetlands should be used to remove pollutants through biological action. Microorganisms and plants in the biologically active layer of soil (close to the surface) and in wetlands are highly effective at removing or detoxifying many of the pollutants in stormwater.

Specialized mechanical means of removing stormwater pollutants should be considered in locations where very high levels of pollutants are generated, such as fuel storage yards, filling stations, and large parking lots. Such systems require regular maintenance, however, and may not be as effective in many cases as simpler, natural systems relying on "biofiltration."

Manage stormwater runoff at construction sites. Construction activities can cause high stormwater runoff, erosion, and pollution discharge into streams and rivers. Avoid soil compaction because heavily compacted soil absorbs water less efficiently. Heavily compacted areas can be made more permeable through "deep ripping." Minimize slope modifications by designing landscapes that respect the original topography of the site, or recontour in a manner that *improves* infiltration. Ensure that heavy equipment is reliable and well maintained and does not leak hydraulic fluid, oil, or fuel. Erect temporary barriers such as straw-bale silt fences to capture sediment in runoff. Regrade and replant disturbed areas (preferably with native plants) as soon as possible.

Infiltration beds, swales, and basins are gently sloping vegetated surface treatments designed to allow stormwater runoff to collect and soak into the ground. Some such basins may become ponds during large storm events—like detention ponds. Pollutant removal occurs through biological activity in the top few inches of the soil ("biofiltration") and through plant uptake of nutrients. Use of native vegetation is most effective.

Detention ponds are designed to temporarily hold water and release it gradually through an outlet channel. They fully drain between storms. The ability of detention ponds to remove pollutants depends on how long the stormwater is detained, what type of vegetation is established, and the amount of infiltration that occurs.

Constructed wetlands and retention ponds are designed to hold water at all times, with excess volume for handling water during storms. Wetland plants and associated root-zone microorganisms provide complex biological processing of nutrients, sediment, and pollutants. Both aerobic and anaerobic breakdown of nutrients and other chemicals can occur in these ecosystems.

References

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